09-689829.

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LNguyen
8/19/04

In the Specification

Please delete paragraph number [0006] and replace it with the following paragraph:

[0006] In typical processes of manufacturing a photomask on a chrome film, a wet etch process may be used in which ammonium cerium (IV) nitrate and perchloric acid are employed. However, the use of a wet etch process in the manufacture of a chrome mask makes it difficult to manufacture the mask with high accuracy as a result of the wet etching processes causing side etching effects/biases. Dry etch processes are also employed for the formation of photomasks on chrome films. A typical dry etch ~~processes~~ process of chrome masking employs the use of a mixed gas of carbon tetrachloride (CCL_4) and oxygen (O_2). The dry etch processes were found to be advantageous for manufacturing a mask with high accuracy, however, the etch rate of chrome using conventional dry etch processes is low. Furthermore, in conventional dry etch processes, the selection ratio of chrome to resist is poor, i.e., during the dry etch of the resist film, the underlying chrome layer etches faster than the photoresist thereby causing defects in such chrome layer.

Please delete paragraph number [0011] and replace it with the following paragraph:

[0011] Another issue that the industry faces as it begins the transition to the use of chemically amplified resists is the formation of a "foot" at the interface between the resist and a CrOxNy surface. This "foot" at the bottom of the post develop

resist profile causes errors in both the nominal mask image size as well as the image size uniformity across the mask. In some cases the "foot" can also cause defects in the photomask pattern. It is believed that the formation of this "foot" is due to the presence of nitrogen in the Cr film and that this nitrogen poisons that resist at the Cr/resist interface leading to the poor image profiles in the resist after develop.

Please delete paragraph number [0021] and replace it with the following paragraph:

[0021] Yet another object of the present invention is to provide a photomask material and method of making such mask that will lead to improved control of the nominal image size.

Please delete paragraph number [0051] and replace it with the following paragraph:

[0051] The present invention provides an improved solution to improving the minimum resolution features that can be achieved on a photomask as well as improving the post develop resist profile that can be achieved on a photomask within current process flows and manufacturing. The instant invention overcomes such problems by advantageously providing the use of a tungsten, tungsten-silicon, tantalum, tantalum-silicon or copper layer as a hardmask/barrier layer directly over a chrome layer which enables an improved pattern transfer mask during chrome

etching processing and improved resist profile after development for advanced photomasks. The instant hardmask/barrier layer provides an improved pattern transfer mask during chrome etching as it is easily dry etched with a fluorine-based etchant, rather than chlorine/oxygen based etchants used for etching chrome layers, and it is easily removed through exposure to hydrogen peroxide solutions. The instant hardmask/barrier layer also prevents the nitrogen rich chrome surface from coming into direct contact with the resist layer, thereby eliminating the source of the resist poisoning and improving the image profile in the resist layer. Tungsten, tungsten-silicon, tantalum, tantalum-silicon or copper materials are preferred as they have been found to have no adverse interaction with the resist layer and they are easily removed from the mask without damaging either the remaining chrome or the quartz substrate, unlike other hardmask materials, such as ~~SiSO$_2$~~ $\underline{SiO_2}$, SiON and SiN, which may damage the chrome and/or quartz substrate when removed. Additionally, tungsten, tungsten-silicon, tantalum, tantalum-silicon or copper materials are preferred as they are conducting materials so that charging induced distortions are not present during electron beam exposure as would be the case with SiO_2, SiN and SiON insulating films.

Please delete paragraph number [0054] and replace it with the following paragraph:

[0054] Preferred embodiments of the invention are illustrated in Figs. 2-9 and 11. Figs. 2-9 and 11 illustrate the steps of forming the instant photomask using a

continuous, thin tungsten, tungsten-silicon, tantalum, tantalum-silicon or copper barrier layer. Preferably, the tungsten-silicon and tantalum-silicon layers ~~comprises~~ comprise a $tungsten_x:silicon_y$, or $tantalum_x:silicon_y$ layer where x = 50 to 100 and y = 0 to 50.

Please delete paragraph number [0062] and replace it with the following paragraph:

[0062] In so doing, as shown in Fig. 4, the fluorine-based etchant removes the resist layer 26 from the surface of the thin tungsten-based hardmask layer 24 and etches the tungsten or tungsten-silicon layer to form a hard mask image 32 in the thin tungsten hardmask layer. As further shown in Fig. 4, the etching of the tungsten or tungsten-silicon layer for formation of the hard mask image 32 does not etch the underlying chrome layer thereby leaving such chrome layer intact. Any remaining resist layer 26 not removed during etching of the tungsten layer may then be removed in a separate dry or wet etch process, or as part of a subsequent chrome etch process.

Please delete paragraph number [0073] and replace it with the following paragraph:

[0073] Subsequently, Fig. 8 illustrates that the resist mask pattern 50 is transferred into the thin tungsten, tungsten-silicon, tantalum, tantalum-silicon or copper based barrier layer 44 and into the opaque chrome layer 42 to form the patterned mask

image 52 in the chrome layer 42. In accordance with the invention, the thin tungsten, tungsten-silicon, tantalum, tantalum-silicon or copper based barrier layer 44 and the opaque chrome layer 42 are etched in a single etch step that uses an etchant sequence that first etches the barrier layer 44 and then etches the ~~chrome layer 46~~ chrome layer 42. In doing so, as shown in Fig. 8, the resist pattern 50 is transferred into the thin tungsten, tungsten-silicon, tantalum, tantalum-silicon or copper based barrier layer 44 and the chrome layer 42.